ABSTRACT

A system for the accurate determination of the position of an underwater vehicle comprising a system observer subsystem having a state velocity update module, a terrain matching module, means for generating a prediction of the terrain matching module's performance and a constrained extended Kalman filter subsystem. The constrained extended Kalman filter subsystem includes a steady state extended Kalman filter, a non-linear constraint module, and a state predictor. The system observer integrates bathymetry data corresponding to the area of the submersible vehicle, with the vessel's measured ocean depth, the vessel's predicted state, the vessel's measured velocity into a terrain based state estimate, a final predicted state; the Kalman filter takes the terrain based state estimate, the final predicted state, the measured slant range and the location of the known point and computes the final estimate of the vessel's position and a prediction of the vessel's position at the next time step. A method for the accurate determination of the position of at least one underwater vehicle comprising the steps of (1) acoustically coupling at least one underwater vehicle to a sea borne position marker having a known position; (2) predicting the at least one underwater vehicle's position, based on a past estimate of the underwater vehicle's position, and an estimate of its velocity over the sea bottom; (3) estimating the underwater vehicle's position utilizing measured ocean depth at the underwater vehicle's position, bathymetry data and the underwater vehicle's predicted position in a single point terrain match; (4) computing a estimate of the underwater vehicle's position based on the prediction of the at least one underwater vehicle's position based on vehicle dynamics and the estimated underwater vehicles position based on ocean depth and bathymetry data; and (5) computing a corrected estimate of the at least one submersible vehicle's position that utilizes the estimate of the underwater vehicle's position and a measured slant range from the at least one submersible vehicle to the sea borne position marker whose position is known.